# INFORMATION SUMMARY
# TO ACCOMPANY REQUESTS FOR PROPOSAL FOR
# CREOSOTE CONTAMINATION STUDY IN ST. LOUIS PARK



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The area to be studied surrounds and includes the site previously occupied by Reilly Tar and Chemical Corporation's Republic Creosote Works, which engaged in the distillation of coal tar products and creosote impregnation for over 50 years, ending in 1971. As a result of the company's operation and waste disposal practices, substantial portions of the soils on and about the plant site and one or more underlying aquifers have been contaminated with coal tar wastes. The area to be studied lies in St. Louis Park, Minnesota, a suburb located directly west of Minneapolis. The Republic Creosote Works was located west of the present Louisiana Avenue estension, south of West 32nd Street, east of Pennsylvania Avenue, and north of Walker Street. The site is now owned by the St. Louis Park Housing and Redevelopment Authority and a portion has been developed as a residential complex.

location

WELLS AT SITE:

An 8-inch well drilled to a depth of approximately 900 to 1,000 feet located on the site is reported to have been severely contaminated with creosote that inadvertently flowed into the casing from a tank car spill. This well is cased to a depth of about 250 feet. The well has not been permanently abandoned but is maintained for monitoring purposes. Another well on the site was drilled in 1946 to a depth of about 100 feet and terminated in the Platteville limestone. The upper termination was completed below grade in the basement of one of the plant buildings. In 1975 this below grade well was covered by a temporary storage pond

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in which contaminated water was impounded. There are a number of additional wells in the vicinity which produce contaminated water. Although the total number of wells in the area that cross connect aquifers is unknown, the U.S.G.S. in 1979, submitted a report identifying all wells of record.

DEPARTMENT OF HEALTH INVOLVEMENT:

In 1932, the City drilled a 16-inch, 540 foot deep well, cased to 280 feet, to provide water for its public water supply. Several water tests showed bacterial contamination, and a disagreeable taste and odor had developed and persisted in the water. Because the water showed persistent bacterial contamination and because the State Health Department could recommend no solution to the taste and odor problem, the department recommended that the City abandon the well. This was done later in the year.

In December Of 1973, the department reported that low levels of phenols had been detected in some municipal wells and in several industrial wells near the site.

In September, 1974, the department issued a "Report on Investigation of Phenol Problem in Private and Municipal Wells in St. Louis Park, Minnesota." Findings of the report indicated the following:

1. Determinable amounts (≥ 0.002 milligrams per liter) of phenolic compunds as phenol in varying concentrations and frequency were found in both private and municipal wells in the St. Louis Park area.



2. Considering the reported depths of the affected wells, it is estimated that phenols can be found in well waters from

the shallower drift wells down to the Pre-cambrian Red Clastics at approximately 900 feet. Spatially, the geographical boundaries of the well sampling pattern extend over much of the St. Louis Park area.

3. Wells in this survey showing the highest concentrations and most consistent phenol levels are located close to the former Republic Creosote property.

4. Chemical analysis of soil borings made south of the former Republic Creosote property indicated that at the test site a black viscous material with a strong creosote odor was found at a depth of 45 feet. Water pumped from a bore test hole in this area also showed a high phenol content at 45 feet. Cores from a depth of 67 feet have a tar-like odor.

Conclusions of the report were:

1. The analyses of the well water samples indicated the presence of a determinable amount of phenol compounds.

2. A review of the wells tested indicated that a majority of these wells contained phenol compounds.

3. From dimensional and construction data of the affected wells, it has been shown that phenols can be found in all formations of the aquifer from the drift formation down to the Pre-cambrian Red Clastics at 900 feet.

4. Consideration of the large amount of waste material discharged on the surface, the extended length of time over which discharge has occurred and the spatial arrangement of affected wells can lead to the conclusion that widespread contamination has

taken place extending perhaps to the farthest tested wells in St. Louis Park and surrounding communities.

Recommendations indicated that:

1. A comprehensive geological and hydrological study should be made to determine the effects of the previous waste disposal practices of the former Republic Creosote Company on the aquifers in the area.

2. A study to determine the feasibility of rehabilitation of the aquifers should be undertaken. If rehabilitation is not possible, a program to confine the contaminants should be considered.

3. An ongoing epidemiological study should be made to see if there are possible public health hazards resulting from the pollution of the affected aquifers.

4. A monitoring system should be established to determine if contamination is spreading with time, and if so, to determine the direction and rate of spread.

5. Contingency plans to protect the present or existing sources of ground water should be developed. Removal of contaminated materials may be necessary to alleviate the chronic source of contamination. Remedial treatment of water before use may also be necessary.

POLLUTION CONTROL AGENCY, ROLE AND EVALUATION OF BARR REPORTS

A report prepared by the staff of the Minnesota Pollution Control Agency in November, 1977, summarized the involvement of the Agency up to that time. The report included an analysis of a report prepared by Barr Engineering Co. Inc., a consultant to the Agency.

In the fall of 1974, storm sewer project plans were submitted by the City of St. Louis Park which would serve the site and surroundir area. The Minnesota Pollution Control Agency determined that a National Pollutant Discharge Elimination System (NPDES) permit would be required. In February of 1975 a hearing on the permit was held and and in April, 1975, a permit was issued. One of the hearing officer's recommendations was that a study be conducted to determine the extent and severity of pollution of underground waters. A study plan was jointly prepared by the City, the Minnesota Department of Health and the Minnesota Pollution Control Agency. The Minnesota Legislature included funds for such a study in the Minnesota Pollution Control Agency's Fiscal Year 1976-1977 appropriation. In November of 1975, the Agency contracted with Barr Engineering, of Bloomington, Minn., to conduct the study. The first phase was completed in May, 1976. The Phase II report was completed in July, 1977.

The Phase I study was to determine the amount and location of coal tar derivatives in the surficial deposits at and near the site. Fourteen soil borings (typically 60 feet deep) were analyzes every five feet in depth for phenols and benzene extrac= tables. In general, the data indicated low levels of benzene extractable and phenol materials in the top 10-15 feet, over most of the site. Highest concentrations of these materials

were found to the south of the Republic Creosote works site between Walker and Lake Streets. Concentrations in these glacial soils generally increased with depth, with high concentrations as deep as 50 feet.

Eleven soil samples were analyzed using thin layer chromatography to determine the presence of polynuclear aromatic hydrocarbons (PAHs). PAH compounds were present in all 11 samples. Of particular importance were the high concentrations of PAH at 32 and 50 feet in the soil columns south of the site between Highway 7 and LakeStreet. Gas chromatograph analyses were then carried out on five of the 11 samples to determine concentrations of various PAHs. The gas chromatograph data indicated detectable amounts of benz(a) pyrene and relatively large amounts of chrysene in two samples. Both of these subatances are known or suspected carcinogens.

The results of the Phase I study guided the design of the final phase. The large quantities of coal tar wastes which were present at depths of 50 and 60 feet and over a relatively large area made excavation of the wastes a financially undesireable solution. The Agency then decided to concentrate its efforts on collecting data on the hydrology of the surface and bedrock aquifers and on their chemical quality. This information would be used to predict future impacts on ground water and to evaluate the feasibility of gradient control as a corrective measure.

The major emphasis of the second phase was the definition of the vertical and horizontal ground water flow through the various glacial and bedrcck aquifers. Well logs and deep soil borings were analyzed in order to develop a more detailed bedrock map of the area.

Soil samples obtained in Phase I and Phase II were physically analyzed to determine the permeability of the various glacial materials. Literature was reviewed to determine permeabilities for the bedrock aquifers. Ground water level information was collected. A ground water model for the area was then developed using the information.

In addition to the ground water movement studies, data was collected on the chemical quality of the ground water in the various aquifers. As in Phase I, the samples were analyzed for phenols and benzene extractable material. Selected samples were also analyzed for the presence of PAH compounds. This information was evaluated to get a general idea about the behavior of the various coal tar derivatives in ground water. The information was also used to test theories on how contamination has taken place and to predict future spread of contamination.

Ground water movement in the upper drift is assumed to be primarily in the vertical direction as lateral flow to the east and west is restricted by the clay layer which nearly rises to the surface. Lateral flow in the middle drift aquifer is to the south and east. In addition there is substantial vertical recharge to the lower drift aquifer. Direction of movement in the lower drift aquifer is not clear, but appears to be primarily vertical. Movement to the east appears minimal due to the thick sequence of silts which make up the lower drift to the east. If this is correct, leakage from the middle drift aquifer to the lower drift aquifer must travel vertically to the underlying Platteville Limestone.

The upper-most bedrock unit underlying most of the study area is the Platteville Limestone. Flow in the Platteville bedrock is generally to the east toward a buried bedrock valley. As with most limestones, flow is predominately through fractures and fissures which have become solution channels.

The Platteville may be underlain by a thin formation called the Glenwood shale. The Glenwood, where present, is a confining layer between the Platteville and the St. Peter sandstone. Where present the shale layer is impermeable enough to maintain an 18 foot head difference between the Platteville and the St. Peter. The Barr report indicates that ground water movement in the St. Peter sandstone appears to be to the east. This flow, however, is greatly influenced by the bedrock valley and existing wells. City well #3, located about 3/4 mile to the north of the site, when pumping, creates a cone of depression and draws water towards it from all directions. The Terry Excavating and Midco Register wells are only cased into the Platteville and terminate in the St. Peter. This means that there is an open hole direct connection from the Platteville through the Glenwood shale to the St. Peter. During periods of non-use, these wells function as recharge points since the head is higher in the Platteville than in the St. Peter.

The second source of recharge is the presence or chance of a bedrock valley. Understanding the bedrock valley and how it affects ground water movement is an important part of the study. The Platteville is generally 33 feet thick in the study area. As a result of erosion prior to the most recent glaciation, part or all of the Platteville was removed.

Data used in the report indicate that at least in the area of Excelsior Boulevard and Highway 100, the erosion also removed the underlying Glenwood shale. Therefore, water reaching the valley through the Platteville or the drift can rapidly recharge the St. Peter since there is no Glenwood to restrict the downward flow. This recharge is quite extensive where the piezometric levels in the southeast are approximately 20 feet higher than levels on the eastern edge of the study area.

Recharge from the St. Peter to the underlying Prairie duChien - Jordan aquifers is limited by a series of siltstones which make up approximately the bottom one-third of the 150 foot thick St. Peter. Under existing conditions, it is estimated it would take 55 years for water to travel vertically through the siltstones. Beneath the Jordon is a series of sandstones, dolomites and shales. The next major aquifers are Mt. Simon - Hinckley sandstones. To simplify calculations only the Eau Claire formation was considered to be limiting flow from the Jordan to the Mt. Simon. Flow time through the Eau Claire is estimated at 34,000 years.

Chemical analysis of surfical ground waters indicate high concentrations of benzene extractables and PAH compounds in the

middle drift aquifer, south of Highway 7. Detectable amounts of PAH were also found at the base of the lower drift aquifer. Previous analyses of existing wells in the area indicated the presence of phenolic compounds in various industrial and municipal wells. These wells are of varying construction and terminate in the major aquifers previously discussed.

From the hydrologic and chemical data, the following general conclusions were drawn by the technical staff of the Minnesota Pollution Control Agency:

1) Ground water in the glacial drift is moving both laterally out of the area and vertically into the Platteville. Water in the Platteville is moving toward the bedrock valley.

2) Coal tar wastes have moved from the surface downward due to water movement and the fact that they are heavier than water. High concentrations of the wastes were found 50 feet deep. These wastes have moved laterally at least 1000 feet. This information suggests that the PAH compounds are present in water reaching the Platteville over a portion of the study area.

3) Phenol concentrations in the drift are likely to be moving southeastward at rates of 30 to 150 feet per year. Water in the Platteville limestone is moving toward the buried valley and will take 20 to 50 years to reach the valley. Water in the drift and the Platteville are not at steady state conditions and concentrations of pollutants will continue to increase further from the site.

4) The buried bedrock valley southeast of the site is a recharge area to the St. Peter. Ground water reaches the valley through the drift and the Platteville. Movement out of the valley will likely be to the east.

5) The uncased wells in the area provide pathways for contaminated water from the drift and Platteville to reach the lower aquifers.

6) Data developed in this study supports earlier findings that low concentrations of phenolic compounds are present in the bedrock wells surrounding the site and at the municipal well field north of the site. Contamination of St. Peter wells south and southeast of the site can be attributed to leakage through the Glenwood-dale or down uncased wells. The available information does not, however, explain the contamination of the St. Peter and Prairie duChien - Jordon wells at the municipal well field north of the site. Contamination of the Mt. Simon - Hinckley well on the site and at the well field are attributed to wastes which have moved down the Hinckley well on the site.

7) Since the quality of the St. Peter is controlled by recharge from the drift and the Platteville, which are not at a steady state condition, it is reasonable to assume that concentrations of contaminants will increase in the St. Peter.

8) The coal tar wastes in the glacial drift represent a potential threat to underlying ground water aquifers due to uncased wells, flow to the bedrock valley, seepage through the Glenwood and due to the fact that down gradient industrial wells that acted as barriers are being abandoned.

Several measures to correct or control this threat were reviewed to varying degrees. These included treatment of municipal water, excavation of contaminated soils, well abandonment and gradient control wells. A preliminary investigation of additional water treatment found this to be extremely costly in comparison to gradient control. Costs to modify the existing treatment to include activated carbon absorption would be approximately $180,000. Costs for carbon alone would run $.34 to $17.00 per thousand gallons or about .75 to 35 million dollars per year if the total water use of the City were treated. This treatment would, of course, not prevent the spread of contamination to wells in other areas.

Excavation of contaminated soils was investigated. This could not be a complete solution since contaminants have moved in the ground waters out of the area of contaminated soils. The depths and amount of excavation required depends upon what concentration of contamination one wishes to remove. For example, the area and depth of excavation necessary to remove soils with 10,000 milligrams per kilogram of benzene extractable material would involve approximately 200,000 cubic yards of excavation. Problems that were not investigated with regard to excavation were disposal of removed material and the

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fact that several industries and Highway 7 are situated above the area to be excavated. No costs were calculated for the excavation alternatives.

Abandonment of all wells which could be potential pathways for contaminated ground water to reach the deeper aquifers is an obvious corrective measure. Several such wells are identified in the study. It is reasonable to assume that many more wells might exist and efforts should be made to locate them. It is estimated that it would cost from $35,000 to $52,000 to abandon the wells which have been located to date. (Since the Barr report was written many wells have been abandoned. This activity is described in detail later in this summary.)

The principal control measure investigated in the Barr report was the use of gradient control wells. The primary purpose of such a system is to control the movement of contaminated ground water such that the size of the affected area does not increase. Although a system of gradient control wells would remove some of the contaminants, gradient control should not be viewed as a method for pumping contamination out of the ground. just stops the spreading of contamination.

Several alternatives were investigated for disposal of the contaminated ground water. These were discharge of all or part of the water to the sanitary sewer and various treatment options prior to discharge to Minnehaha Creek. The design of a treatment system would be difficult at the present time since the quality of the water to be treated is not known. After gradient control the wells are operational, a better idea of the type and cost of treatment facilities could be determined. The capital cost of hooking the wells up to the sewer was then estimated to be $8,000.

Barr Engineering made the following recommendations for corrective action and future studies:

1. All bedrock wells constructed so as to provide pathways for ground water to move between the drift/Platteville and St. Peter and between the St. Peter or Prairie du Chien-Jordan and Mt. Simon-Hinckley aquifers should be grouted and abandoned. Highest priority should be given to locating and abandoning wells in the area bounded by Texas Avenue on the west; Minnetonka Boulevard on the north, Highway 100 on the east and Minnehaha Creek and Excelsior Boulevard on the south. Wells in this area should be located and abandoned immediately. The investigations summarized in this report indicate that these wells present potential pathways for the movement of coal-tar derivatives to the lower aquifers and, in fact, represent the only reasonable means by which ground water in the Prairie du Chien-Jordan and in the Mt. Simon-Hinckley formation could be contaminated with waste from the site of the former coal-tar distillation and wood-preserving facility.

2. Since the abandonment of uncased wells near the site will likely result in the movement of recharge from the buried valley to the St. Louis Park municipal well field to the north, St. Louis Park wells 1, 2 and 3 should also be abandoned.

3. The potential impact of the identified high concentrations of coal-tar derivatives in the glacial drift ground water are significant enough that mitigative measures are recommended to halt the movement of these wastes. how about litigative?

4. The control of ground water gradients in the glacial drift ground water system is technically feasible and the system presented in this report or a similar system should be implemented. It is recommended that design of the gradient control wells begin immediately. The first step in the design will be to place the additional wells and borings needed to define the exact location of gradient control wells. The next step will be to place one or more test wells to verify the aquifer characteristics needed to complete the design. The third step will be to complete the design and construct the wells.

5. Water pumped from the gradient control wells should be discharged to the sanitary sewer, at least initially. After the more highly contaminated ground water has been removed from the glacial drift or after treatability of the waste has been better defined, it may be possible to discharge the effluent from the wells to Minnehaha Creek after appropriate treatment.

6. Bench scale and pilot scale studies should be conducted to define the treatability of the ground water using either the existing surface water treatment facility or a new treatment concept.

7. The effectiveness of the gradient control system should be monitored both in terms of the ability of the wells to capture coal-tar derivatives through the glacial drift and Platteville limestone and, if the effluent is discharged to Minnehaha Creek, the ability of the treatment facility to meet effluent limitations prior to discharge.

8. Two additional wells should be placed in the St. Peter formation beneath the area of elevated coal-tar derivative at the drift/Platteville contact to monitor the quality of water in the St. Peter. If the average concentration of the phenolics, as measured by the MBTH Method, exceeds a concentration on the order of 20 micrograms per liter, significant change will have occurred and gradient control or some other appropriate mitigative measure should be required to control movement of the wastes in the St. Peter.

9. Further information is needed regarding the effect of the trace phenolic concentrations measured in the municipal wells in St. Louis Park. It is recommended that studies be carried out to define the potential public health effect of these trace phenolics.

10. A better definition of hydrogeology is needed in the buried bedrock valley located near Highway 100 and Excelsior Boulevard. Specifically, soil borings and piezometers should be placed in the valley to define its extent and to estimate gradients and likely vertical

placed near the western edge of the valley to define the quality of water discharged to the valley from the site area through the glacial drift, Platteville and St. Peter units. A monitoring well should also be placed in the St. Peter north of the valley to monitor the quality of the water in the aquifer between the valley and the City well field to the north.

The staff of the Minnesota Pollution Control Agency recommended that the following steps be taken:

1) The Barr Engineering recommendations 1 and 2 regarding well abandonment should be carried out immediately.

2) The barrier well system as outlined by Barr Engineering should be designed and constructed. The design should be preceeded by the studies outlined in the report . In addition, studies to determine the possible existence of a buried valley immediately south of the site which is eroded through the Glenwood shale should be conducted. The studies should commence immediately with construction as soon as design is complete.

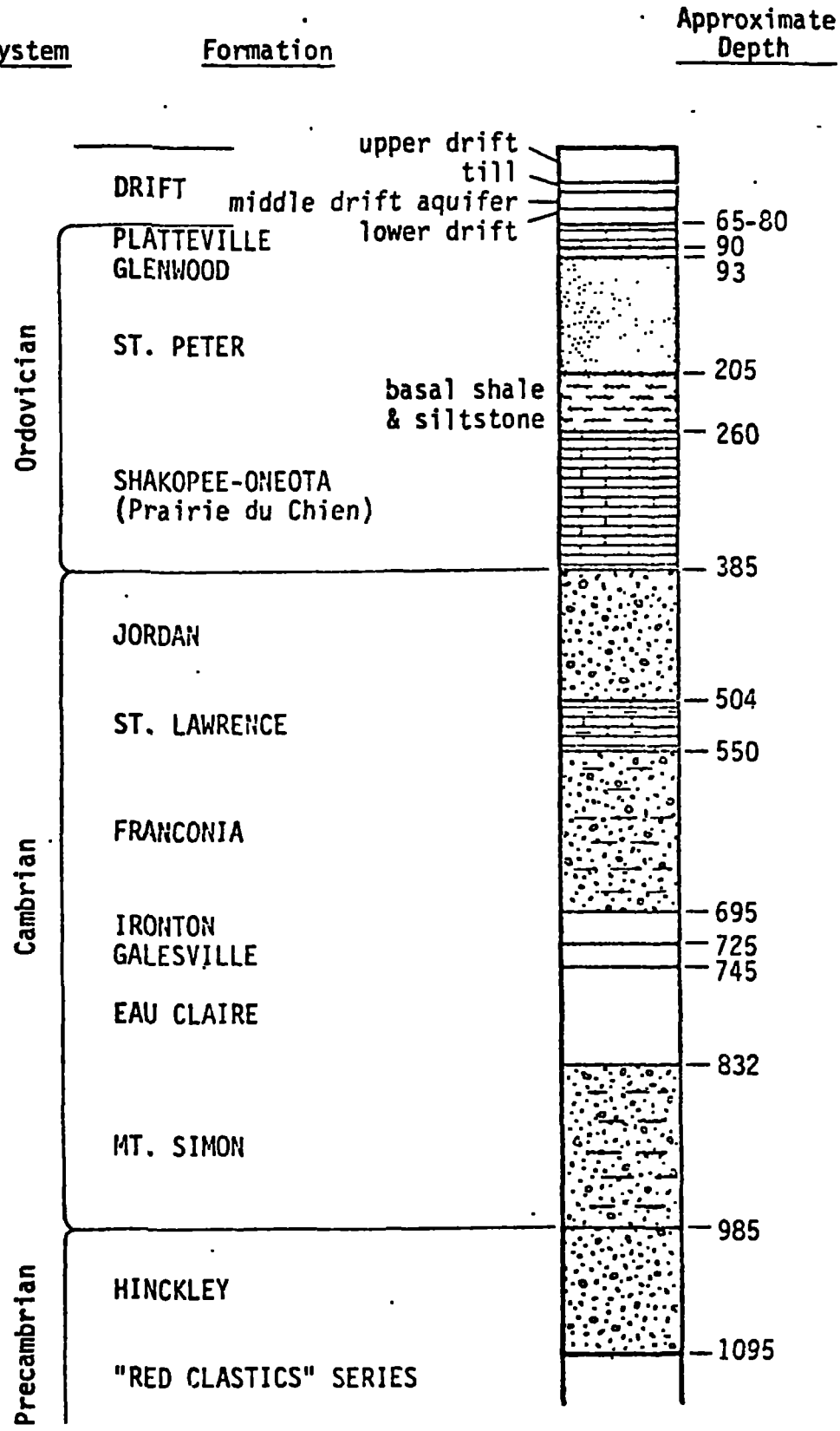
3) Water pumped from the gradient control wells should be either pretreated for removal of PAH compounds prior to discharge to the sewer system or should be treated to allow discharge to Minnehaha Creek. Limited untreated discharges to the sewer system should be allowed in order to collect sufficient data for treatment plant design.



4) Monitoring the effectiveness of the gradient control system should be conducted.

5) Barr Engineering's recommendation 8 with regard to the construction and operation of two wells to monitor quality of water in the St. Peter beneath the site should be implemented.

6) Barr Engineering's recommendation 10 for additional monitoring of the St. Peter near the bedrock valley southeast of the site, should be carried out. If the additional study in staff recommendation 2 locates a comparable valley south of the site, similar monitoring should be carried out in the St. Peter in that area.

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GENERALIZED GEOLOGIC COLUMN

WELL ABANDONMENT--MINNESOTA DEPARTMENT OF HEALTH:

*STATUS OF WELL ABANDONMENT*
*PRIVATE WELLS*
*ST. LOUIS PARK*

*NOVEMBER 13, 1979*

NON-RESPONSIVE

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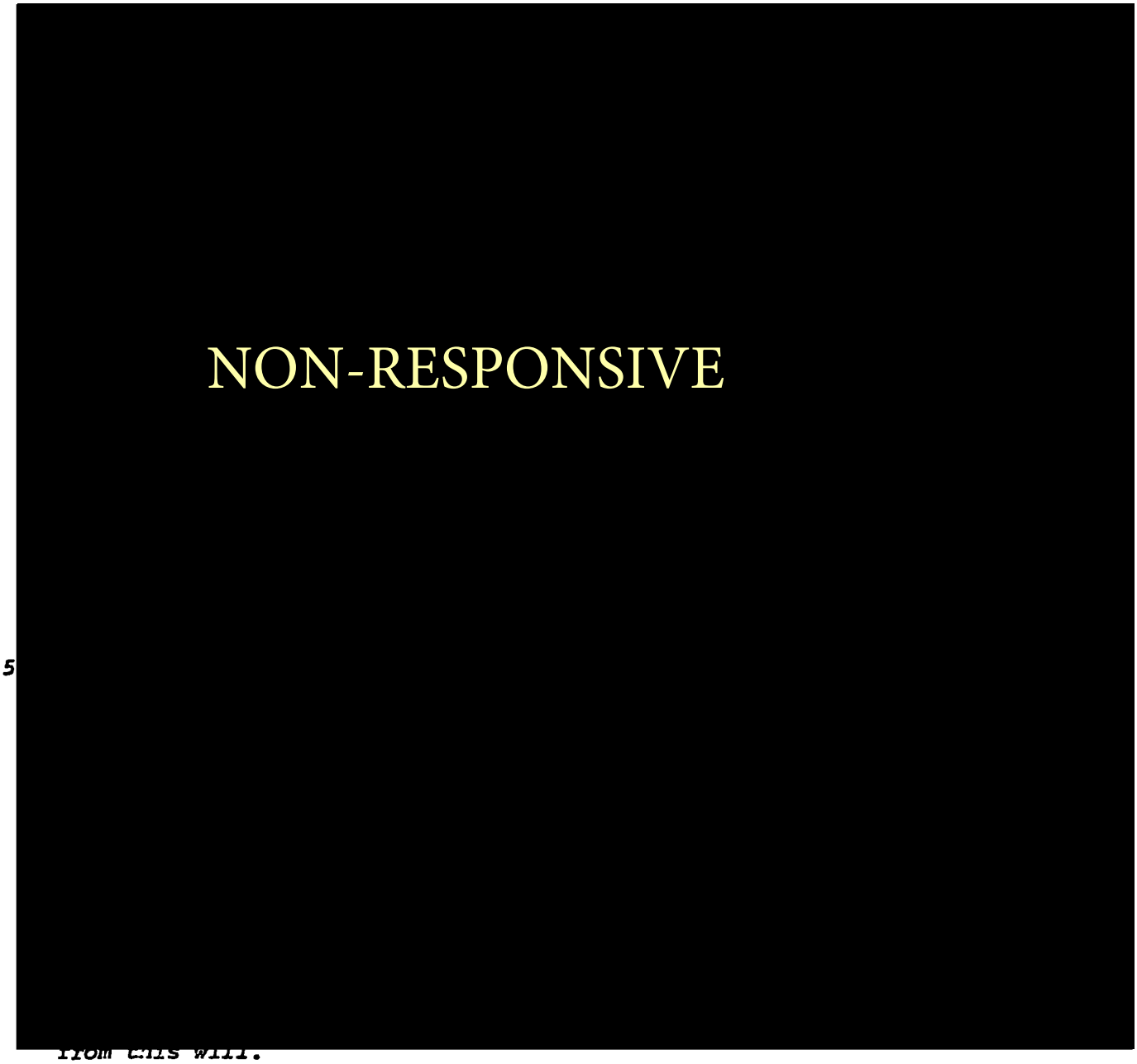


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RISK ASSESSMENT -- MINNESOTA DEPARTMENT OF HEALTH:

In October, 1977, the department released a report entitled "Assessment of Possible Health Effects Resulting from the Contamination of the Former Republic Creosote Site." In part, the report contained an assessment of the existing and potential human health risk resulting from the contamination of the Republic Creosote site based on information which was then available. The focus of concern over human exposures to creosote and coal tar wastes is the possibility that the polynuclear aromatic hydrocarbon compounds contained therein will induce cancer. A complete assessment of existing and potential health risk would require the following information, none of which is available at this time:

1. To what extent is the groundwater, and more specifically the municipal water supplies, in the area contaminated with carcinogenic PAH compounds? There are no data available on specific PAH compounds in groundwater in the area of the site.

2. What are the directions and speed of the spread of the contamination from the site? This question must be addressed for the vertical travel of the material to the deep aquifers and for the flow leaving the site area laterally. A complete treatment of this problem would also involve a determination of which fraction of

the material is actually in a water solution and which is moving as an independent phase. Also needed would be information on the position of the buried bedrock valley to the east of the site and the porosity of the material within it. Although Barr Engineering Phase II report was an in-depth treatment of certain aspects of the problem, many geohydrologic questions + Hydrogeologic remain unanswered.

3. What population groups are presently or potentially exposed to drinking water contaminated with PAH compounds from the site?

4. Are there significant exposures to airborne PAH compounds? Although the creosote and coal-tar are contained in the soil, the soil does not present an absolute barrier to PAH vapors.

5. Is there a potential exposure from external contact with the contaminated soil by future residential populations or to those involved in construction activities on the site?

Since this information was unavailable, the department assessment was necessarily limited. The analysis dealt only with the contamination of the drinking water supplies of St. Louis Park and Edina, Minn. The contamination of additional municipal drinking water supplies, and exposure to these contaminants in the air or by direct contact may create greater risks to the public's health than the contamination identified in the two drinking water supplies studied.

The St. Louis Park and Edina supplies have been shown to contain trace quantities of phenols, a major constituent of creosote. The presence of phenols suggests the presence of other more harmful components of creosote and coal tar such as the carcinogens benzo(a)pyrene,* benzo(a)anthracene, dibenz(a,h)anthracene, benzo-(b)fluoranthene, benzo(j)fluoranthene and chrysene. Because the analytical methods in use at that time did not show any detectable concentrations of these carcinogenic PAHs, this assessment makes use of an estimated benzpyrene concentration in the water supplies of the two communities. It was assumed that the low levels of phenols which have been measured in the St. Louis Park and Edina water supplies are associated with total PAHs in the same ratio as has been measured for ground water samples collected in

*The nomenclature for the above listed compounds is the official nomenclature designated by the Intl. Union of Pure and Applied Chemistry (I.U.P.A.C.). Other more common names are often used in the literature, e.g., benzo(a)pyrene is also called 3,4-benzpyrene, benzpyrene, and abbreviated BP. In this report the more familiar common name benzpyrene or the abbreviation BP will be used.

the site area. It was also assumed that the resulting estimated total PAH values are associated with benzpyrene in the same ratio as has been found by Borneff and Kunte in samples of unpolluted European ground water. The imprecision of the assumption relating to the PAH to phenol ratio will influence the final comparison of maximum acceptable concentration vs. the estimated exposure.

Using specific well pump rates, it was calculated that the average St. Louis Park resident received a concentration of 3.66 micrograms of phenols/liter in his drinking water. A similar analysis of phenol concentrations on samples collected from the Edina system during July of 1975 show an average of 4.33 micrograms/liter.

The amount of benzpyrene associated with these phenol concentrations was estimated. The ratio of PAH to phenol for Well 17 from the Barr Phase II Report is 10.6. The ratio of benzpyrene to PAH as determined by Borneff and Kunte for unpolluted ground water is 0.01 (average of two samples). The value of 0.01 is consistent with BP/PAH ratios which have been measured for a wide variety of environmental samples as well as for creosote and coal tar in the pure state. The average estimated concentration of benzpyrene in the water supplies of the two communities can then be calculated as follows:

$$BP(\text{St. Louis Park}) = (3.66\ \mu g\ \text{phenol}/l)(10.6\ \text{PAH/phenol})(0.01\ \text{BP/PAH}) = 0.39\ \mu g/l$$

$$BP\ (\text{Edina}) = (4.33\ \mu g\ \text{phenol}/l)(10.6\ \text{PAH/phenol})(0/01\ \text{BP/PAH}) = 0.46\ \mu g/l$$

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A maximum acceptable level for humans of $3.1 \times 10^{-4}$ micrograms Benz-a-pyrene per liter in drinking water was derived based on data obtained from animal studies.

Upon examination of the results of the calculations of the assessment, it was apparent the estimated exposure is about 1,000 times higher than the maximum acceptable exposure, suggesting the existence of a serious public health problem. Secondly, the maximum acceptable concentration is very low ($3.1 \times 10^{-4}$ µg/l).

The health risk assessment report recommended that a number of additional studies would be necessary to quantify the extent of human exposure to carcinogenic PAH compounds in drinking water supplies of St. Louis Park and Edina.

Geohydrology studies and related environmental monitoring recommended in the assessment included the following items:

1. Further work should be done to establish the assumed presence or absence of the Glenwood shale in the erosional valley immediately south of the site. Absence of the shale would provide a connection between the drift and the St. Peter allowing rapid contamination of this aquifer.

2. The piezometric head gradients, the porosity and the amount of solution channeling should be determined for the Platteville formation. An analysis should then be done of the direction and rate of flow in the Platteville for all seasons and under a variety of local pumping conditions. A system of monitoring wells should then be designed to establish the existing extent and future movement of contamination in the Platteville.

3. Further work should be done to determine the possible source of the coal tar taste in old city well #1 which was apparently abandoned in 1932. This well extends into the St. Lawrence shale and is cased to the top 60 feet of the Shakopee limestone. The presence of a coal tar taste in the water from this well could possibly indicate that the Prairie du Chien-Jordon is seriously contaminated in the study area.

4. The buried bedrock valley to the east of the site should be examined to determine the presence or absence of a high permeability "pipeline" at the bottom of the valley. A pipeline at the bottom of a buried bedrock valley can provide a rapid travel path for contaminated ground water. If this condition exists in the valley east of the site it could accelerate the spreading of the coal tar wastes areally and vertically into bedrock aquifers through which the valley has cut.

5. Solubility studies should be done on coal tar wastes to determine to what extent constituents of these material are soluble in groundwater under environmental conditions. This solubility data as well as data on the desorption of these materials from soil particles are necessary to predict their future concentration and movement through the underground.

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6. The source of the high concentrations of phenols in the Robinson Rubber Company well should be determined. Identification of the aquifer which is responsible for the contamination of this well would be useful in determining the directions of flow of contaminated water leaving the site.
7. Selected wells in the immediate area of the site plus all St. Louis Park and Edina municipal wells plus other, yet to be determined, downstream monitoring wells will be analyzed for trace PAH contamination quarterly for one year.

The Minnesota Department of Health health risk assessment concluded that there exists a significant potential impact on human health resulting from the contamination of the Republic Creosote site. However, future studies may indicate that no health risk exists. The following recommendations will, hopefully, provide a basis for a course of action to protect the public's health.

1. There is a need for further environmental, epidemiological, and geohydrological studies to provide the information necessary for a complete assessment of health risk and for future decisions regarding corrective measures.

The necessity for these studies is independent of whatever mitigating measures are taken at this time since no such measures are capable of removing contamination which has left the site area.

At this time, the Minnesota Department of Health plans to attempt to conduct all the environmental monitoring and epidemiological studies during the 78-80 biennium. The scarcity of available resources may prevent sufficient progress to complete the expanded risk assessment within this time period.

2. The plan for the location and abandonment of interconnecting wells and St. Louis Park wells 1, 2, and 3, contained in the Barr Phase II Report, should be implemented with the exception of the abandonment of the Robinson Rubber Company well. This well is approximately 180 feet deep and is highly contaminated. Rather than grouting the well at this time, the well should be studied to determine which aquifer is the source of the contamination. This information will be valuable in assessing the depth which the contamination has reached. Upon completion of the study, the well should, of course, be grouted and abandoned.



3. That a pumpout and barrier well system be designed and implemented which is capable of removing and halting the spread of contaminated water in the drift and

Platteville aquifers and any deeper aquifer which the geohydrologic studies show to be significantly contaminated. This system is more extensive than the pumpout and barrier well system recommended by the Barr report which only dealt with the drift aquifer. There is strong evidence that the Platteville is contaminated and this limestone formation may contain solution channels which could hasten the spread of not only the water soluble portion of creosote and coal tar wastes, but also the thicker fractions which are not in solution. The effluent of the pumpout and barrier well system must receive sufficient treatment to remove a large portion of the PAH compounds contained therein. The Barr Phase II Report recommended the discharge of this effluent to the sewer. A review of the available literature indicates that conventional sewage treatment processes will be ineffective in the removal of benzpyrene and other PAH compounds. Since any discharge of this material to the sewer will eventually result in the addition of carcinogenic material to the drinking water of downstream communities, the waste should be treated to remove harmful components.

4. That if, upon completion of the geohydrologic studies there is no reasonable assurance that the waste will remain in place and will not spread, either in the ground water or as a separate non-soluble phase, either vertically to aquifers below the Platteville or laterally beyond the control of the pumpout and barrier well system, the contaminated soil (as defined in the Barr Phase II Report 1 mg/kg phenol) should be excavated from the site and disposed of in such a way as to not create a significant hazard to human health.

MINNESOTA GEOLOGICAL SURVEY -- EVALUATION OF BARR REPORT:

The Minnesota Geological Survey provided a review of the Barr Engineering report indicating that subsurface data permit several interpretations of the bedrock geologic and hydrologic conditions near the creosote site in St. Louis Park. The Minnesota Geological Survey review tends to question the hydrologic modeling and ground water gradient control wells recommended in the Barr report. Also questioned were the assumptions suggested or proposed to predict contamination migration. The Minnesota Geological Survey review is provided herewith in its entirety.

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UNIVERSITY OF MINNESOTA
TWIN CITIES

Minnesota Geological Survey
1633 Eustis Street
St. Paul, Minnesota 55108
(612) 373-3372



October 17, 1977



Mr. Dale L. Wikre
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, MN 55113

Dear Dale:

We have reviewed the Barr Engineering report entitled "Soil and Groundwater Investigation of the Coal Tar Distillation and Wood Preserving Site, St. Louis Park, MN." Upon reviewing the available geological information, we suggest that another interpretation of the bedrock topography and geology can be postulated particularily for the areas east and southeast of the site of investigations.

Our records of borings ST-1 and ST-53 located at the extension of Louisianna Avenue over the Chicago, Milwaukee, St. Paul, and Pacific Railroad tracks do not indicate the presence of the Platteville limestone as do the records of these borings shown graphically in figure 3 of the Barr report. Our copy of ST-1 indicates the Glenwood Formation was penetrated at a depth of 84 feet and the St. Peter Sandstone at 87 feet. ST-53 encountered St. Peter Sandstone at a depth of 84 feet with no Platteville but possibly some Glenwood overlying it. ST-64, a boring near these other two which is not presented in the Barr report, penetrated only St. Peter Sandstone at a depth of 98 feet. If our copies of borings ST-1, ST-53, and ST-64 are accurate, then the bedrock river channel southeast of the creosote site (p.III-9 and figure 7, Barr report) is cut into the St. Peter Sandstone and not just into the Glenwood Formation as postulated. We are enclosing duplicates of our copies of these borings which we obtained from the Minnesota Department of Transportation.

Additional evidence favoring a St. Peter channel southeast of the old creosote site can be obtained through another interpretation of the log for the Methodist Hospital well. The Barr report implies that since their calculated average thickness for the St. Peter Sandstone (165 feet, p. III-11) was nearly penetrated by the well (163 feet), Glenwood shale could be assumed to be present but not described (p. III-10). It is not uncommon for the St. Peter to be reported as two to four feet thicker than the Barr Engineering calculated average and so it may be possible that more than 163 feet of sandstone may have existed at the well site.



The log of a test hole for the elevator shaft at Methodist Hospital indicates that the Platteville limestone was encountered at a depth of

60 feet. The log of the Methodist Hospital well reports penetrating St. Peter Sandstone as the first bedrock at 94 feet. If the difference in land surface elevation between the elevator shaft and the waterwell site was no more than five feet during construction of the hospital, then there would be about 29 feet of bedrock eroded between the elevator shaft and the well (94 minus 65).

Well logs about one half mile north of the hospital indicate 20 to 23 feet of Platteville remaining. Well logs in Edina about three quarters of a mile southwest of the hospital report about two to ten feet of Platteville while the record of St. Louis Park Well No. 6 about five eighths of a mile to the southeast reports about 32 feet. If well logs closest to Methodist Hospital are any indication of the thickness of remaining Platteville, then about 20 to 23 feet of Platteville should underly the site for the hospital elevator shaft and about the same amount should have been eroded at the hospital well site. This estimate would leave six to nine feet of bedrock or about three feet of Glenwood and about three to six feet of St. Peter Sandstone to be eroded in order to have St. Peter occur under 94 feet of glacial deposits at the hospital well site. Therefore, it is possible that the well log for Methodist Hospital is accurate in reporting the St. Peter Sandstone as the first bedrock and that its upper three to six feet have been eroded. This interpretation would indicate that Methodist Hospital overlys the lip of a buried river channel cut into the St. Peter Sandstone. I am enclosing copies of the geologic logs for the elevator shaft and for the waterwell at Methodist Hospital.

A bedrock geologic and topographic map based upon our copies of borings ST-1, ST-53, and ST-64 and our interpretation of the Methodist Hospital data indicates that a bedrock channel cut into the St. Peter Sandstone extends at least as far north toward the old creosote site as the extension of Louisiana Avenue over the Chicago Milwaukee, St. Paul, and Pacific Railroad tracks. We are enclosing a copy of this map. The generalized bedrock topography compiled from waterwell records and test boring logs lends support to the existence of a southeastern bedrock channel. The width of this channel cut into the St. Peter Sandstone could be approximately one city block or about as wide as the gorge cut into the St. Peter Sandstone just downstream from Minnehaha Falls. The southeast channel shown in figure 7 of the Barr report is similar in width but they interpret the bottom of this channel as lined with Glenwood shale.

Observations of channels cut through Platteville limestone such as at Minnehaha Falls do not indicate that these channels bottom in the Glenwood Formation. The Glenwood is easily eroded and especially subject to waterfall recession which is believed to have been the mechanism which formed channels cut through the Platteville in the Twin City area. Assuming a St. Peter channel is present southeast of the old creosote site, probably about 10 to 15 feet of St. Peter Sandstone has been removed at the waterfall but progressively more sandstone would have been removed by water action downstream if surface observations such as at Minnehaha Falls are an accurate analogue.

In addition to the southeastern channel, we suggest the channel underlying Wooddale Avenue (figure 7) is also probably cut into the St. Peter Sandstone and not just into the Glenwood Formation. Records for the abandoned St. Louis Park well at 6021 West 36th Street and for the Minnesota Rubber Company well at 3630 Wooddale Avenue each report St. Peter Sandstone as the first bedrock penetrated. The record of the Milwaukee Railroad well at Wooddale Avenue and the railroad tracks reports only four feet of limestone and shale overlying the St. Peter Sandstone and suggests the area between these three wells may mark the northern edge of a St. Peter channel whose center would lie to the southeast. We are enclosing copies of the three well logs.

The results of the hydrogeologic model in the Barr report will change if the above geologic interpolations are accepted. The buried bedrock channels southeast and east of the creosote site would create a larger recharge area for the St. Peter than depicted in the Barr Report. This situation would be especially important if valley fill deposits in the southeastern channel were permeable and hydrologically connected to the middle drift aquifer. The Platteville limestone might also discharge into the southeastern bedrock valley particularly along the Platteville-Glenwood shale contact, thereby permitting contaminants from other areas to recharge the St. Peter in addition to those directly recharging above the buried valley through the middle drift aquifer. The piezometric levels for the St. Peter in figures 18 and 19 would also be different possibly resulting in steeper gradients from the axis of the buried bedrock valleys to the city wells 1, 2, and 3. Groundwater flow lines, velocities, and travel times in the St. Peter will also change. The piezometric lines for the Prairie du Chien-Jordan aquifer in figures 20 and 21 might change, but this would have to be checked by the model. Because the presence of the two St. Peter channels will have a major impact on present hydrogeologic modeling and upon future groundwater gradient control measures, we suggest that additional test borings be placed to establish the lithology of the first bedrock at the bottom of each channel, to define channel morphology, and to determine channel hydrology.

We also have questions regarding boundary conditions established for the hydrogeologic model. The eastern and western piezometric levels of the St. Peter and the Prairie du Chien-Jordan aquifers were taken from piezometric contours illustrated in the Norvitch report (1973) as cited by Barr. The Norvitch report used 1:250,000 scale maps with 25 to 50 foot contour intervals. If the placement of these piezometric contours was not precise or if locations of those contours had shifted by the time the Barr report was initiated, then it is possible that the resultant gradients for the bedrock aquifers in the Barr report could be different. Also, on pages III-27 and III-28 of the Barr report, four wells are discarded as affecting bedrock boundary conditions. We question the assumptions and reasons used to eliminate these wells and suggest that Barr should first include these four wells and eliminate them only when the model verifies that they have a negligible affect upon defining piezometric levels in the bedrock aquifers. The model also uses aquifer

for the specific storage (page E-1) or the porosity (page IV-14) assigned to the Glenwood shale.

Another aspect of the Barr report which needs clarification is the assumptions used to predict contaminant migration. Barr postulates that the contaminants and the groundwater move as a single-phase flow rather than a possible multiple-phase flow system. Information regarding the solubilities of the various contaminants is necessary to investigate this, but no such information is presented in the Barr report. The contaminants could be moving at different velocities and directions than the groundwater and could possibly be trapped in areas of changing grain size creating stagnant pockets. Groundwater might continue to leach soluble parts of these trapped contaminants for longer periods than those determined by the results in figure 23. This could greatly alter the effectiveness of gradient control wells. We suggest that more information regarding the mobility of the contaminants be presented before initiating a gradient control well system.

In conclusion, the information we are presenting demonstrates that the available subsurface data permits several interpretations of the bedrock geologic and hydrologic conditions near the creosote site in St. Louis Park. Our opinion is that the bedrock channels depicted in the Barr report, and modified in our interpretation, probably cut into the St. Peter Sandstone. This interpretation of the geology would greatly add potential recharge areas to the St. Peter and could alter present hydrologic modeling. We also suggest that a re-evaluation of the data used in modeling might also alter the present interpretation of bedrock hydrology. We recommend that future remedial measures, particularly groundwater gradient controls, would be more effective if the geology and hydrology of the buried bedrock channels east and southeast of the creosote site were precisely defined.

Sincerely,

Bruce Olsen

Bruce Olsen

Gilbert Gabanski

Gilbert Gabanski

Encl.

BO/GG/jh

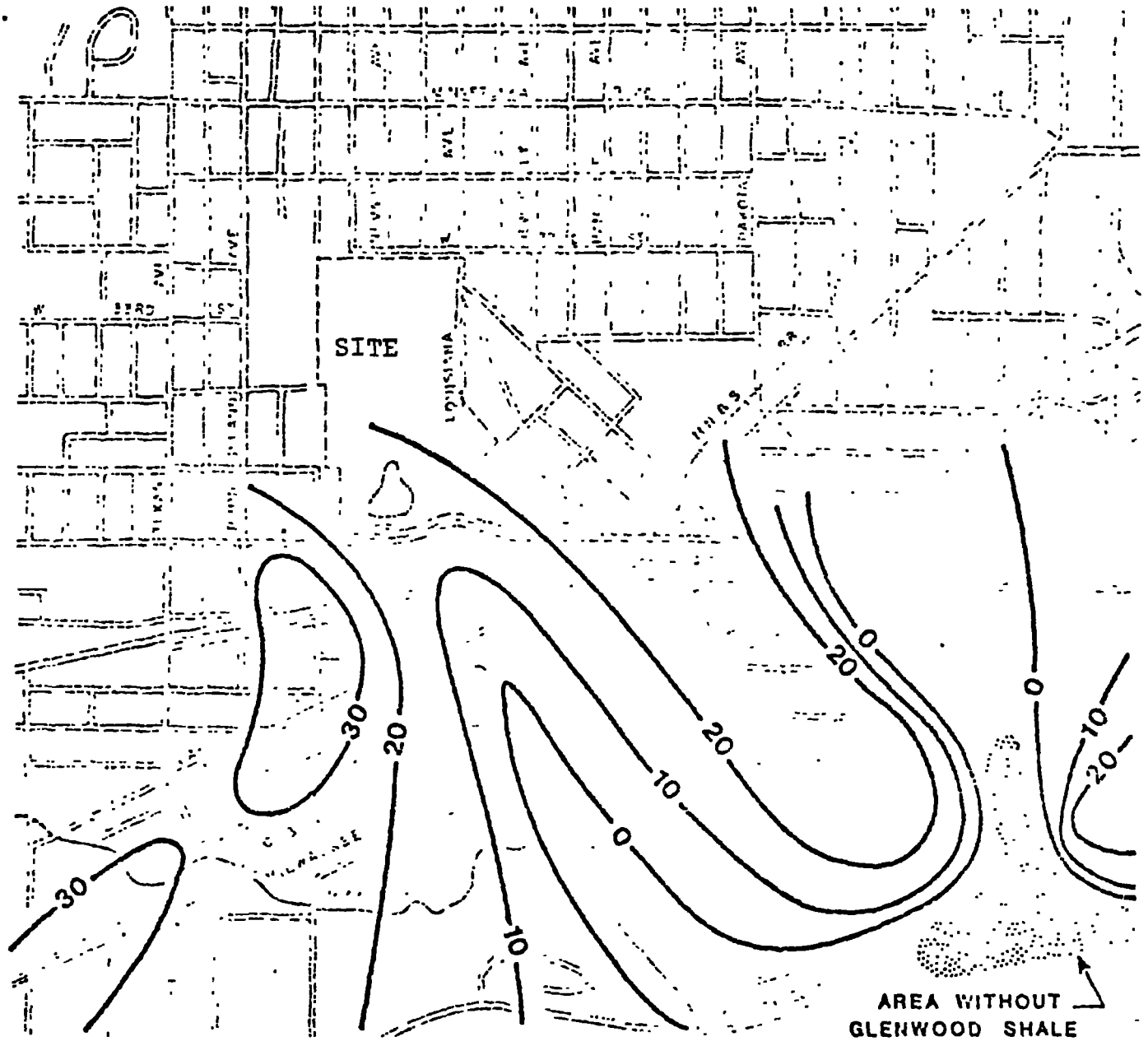


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FIGURE 7 Barr Report

THICKNESS OF THE PLATTEVILLE LIMESTONE FORMATION (FEET)

(indicating approximate limits of buried bedrock valleys)

U.S. GEOLOGICAL SURVEY STUDY:

The U.S. Geological Survey, under contract to the Minnesota Department of Health, has been conducting a hydrological and geochemical study of the St. Louis Park area, to develop a detailed understanding of the groundwater flow system and transport of organic contaminants. The study is to be completed by June 1980. The general area of study extends three miles east and two miles south of the site. A preliminary report outlining the information gathered through June 1979 was released November 1979, containing 55 figures describing the geologic and hydrologic conditions of the study area.

Preliminary results of this report indicate that there appear to be three major sources of contamination:

1. infiltration of hydrocarbons spilled on site;
2. runoff of contaminants from the site and discharge of wastewaters into disposal ponds south of the site; and
3. introduction directly through the deep, multiaquifer well (909') on the site.

In addition, at least 25 ungrouted or partially cased wells exist in the vicinity of the site and these may permit contaminated water from near-surface aquifers to flow downward into deeper bedrock aquifers. Flow rates estimated by geophysical logging and inspection with downhole television cameras range from 20 to 150 gpm. Most of these wells have been logged with a downhole television camera by the Minnesota Department of Health or geophysically logged by the U.S.G.S. This information, along with drillers' logs, water level measurements, and survey reports are available from the U.S.G.S.



Dissolved constituents in the drift and the Platteville Limestone have moved at least 4,000 feet down the hydraulic gradient (east-southeast) towards a drift-filled valley. Soil borings and well logs indicate two branches associated with the buried bedrock valley, which are ½-1 mile southeast of the site. The extent of this valley

is currently being better defined by the U.S.G.S. The valley appears to be a recharge area for the lower aquifers from the upper bedrock units.

Due to heavy and extensive groundwater utilization by municipal and industrial users, the groundwater flow systems in the Prairie du Chien aquifer are extremely complex. The distribution of contaminants is likewise complex.

The extent of contamination in the Mt. Simon-Hinckley aquifer is unknown. Contaminants have been introduced through the well on the site, so there remains a potential of further contamination spread.

The U.S.G.S. has also investigated the distribution of sodium, nitrate, ammonia, dissolved organic carbon, and total organic carbon in the Middle Drift and Platteville aquifers. Further work remains to be completed, but the current data indicate that these components are migrating to the east-southeast, with the exception of nitrates, which are decreasing (due to microbial utilization).

Studies are currently being conducted measuring dispersivity of NaCl and phenol in column packs of sand. In addition, a three-dimensional dispersivity-diffusion computer model is being developed and calibrated by the U.S.G.S. This model will be available to the consultant(s) for use.